

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1937

WHILE the funded resources of the institution remain as at the close of the previous year, the establishment of the Maria Moors Cabot Foundation for Botanical Research in June, 1937, enables us to amplify our work in certain fields. The initial endowment of this Foundation, the munificent gift of Doctor Godfrey L. Cabot of Boston, is \$615,773.00. The income from this fund is allocated to support special investigations in various parts of Harvard University, the Harvard Forest, the Biological Laboratory, the Arnold Arboretum, and the Bussey Institution.

The numerous friends of the Arboretum, scattered all over the United States and Canada have responded generously to its needs. Gifts for cultural purposes up to the end of the fiscal year amounted to about \$10,560.00. The appeal this year, the first one made since 1930, was to provide supplementary library funds, to permit the amplification of botanical-horticultural exploration, and to develop a larger nursery on the Walter Street tract. Supplementing these unrestricted gifts, available for immediate use, \$6500.00 has been received or promised for special purposes, particularly to cover publication costs. On the basis of what has been received, it is possible to plan a somewhat amplified program during the coming year. We are particularly grateful to the donors of these special small and large gifts, as these funds, being extra-budgetary, enable us to accomplish much-needed investigations, or to undertake needed improvements that it was impossible to finance on the basis of the regular institutional income.

Building and Grounds.—Fortunate in having an unusually mild winter with little or no winter killing of buds, the floral displays at the Arboretum in May and June were unusually attractive. These are the months when the institution is most extensively visited by the public, and within recent years there has been a very noticeable increase in visitors. A careful check of visitors on lilac Sunday, May 23, 1937, indicated an approximate attendance of 40,000 on that one day.

The usual program has been followed in the maintenance of grounds and plantings, involving some thinning and transplanting, the removal of overgrown and moribund plants, and spraying for protection against noxious insects and fungus diseases. Necessary repairs have been made to buildings as required, the most extensive operations being on the

administration building, involving roof and gutter repairs and the pointing up of all masonry construction. A new trellis was constructed for the Wisteria collection.

Horticulture. — In an attempt to make the Arboretum more useful to the community and to the horticulturally minded public in the country at large, considerable progress has been made. Over fifty illustrated lectures were given to various groups on the scope and work of the institution. In the spring, personally conducted tours were arranged for thirty organizations. For use in connection with these lectures, approximately 400 new natural color slides have been prepared, bringing our collection up to about 700. Preliminary work has been done on a series of natural color films, planned to illustrate the attractions of the Arboretum at various seasons. It is anticipated that these will be completed during the coming year.

During the year the hedge demonstration planting was completed, involving plantings averaging 20 feet in length, covering 115 different species. The Wisteria collections were removed from the old site near the Forest Hills entrance, a new trellis was constructed, and all species were replanted near the Bussey Institution building; in close proximity to this planting a collection of 35 named varieties of tree peonies, generously presented by Mr. John Wister, was installed.

The extensive use of fertilizers is being continued, and the response of the treated plantings is noticeable. It is believed that this policy should be consistently followed to compensate, in some degree, for the relatively poor soil characteristic of much of the arboretum area.

The spring plantings involved the actual placing of 521 new plants in various parts of the grounds. In connection with this work the old nursery was entirely rearranged, those shrubs and trees destined for planting in our own grounds being arranged in one area, and the duplicates and material not needed, destined for gifts or exchange purposes, arranged in another section. To take care of urgent additional nursery needs, arrangements have been made to establish a large supplementary nursery on the undeveloped Walter Street tract. New beds were prepared for the willow collection, the *Rubus* material was removed from the shrub collection to the Peters Hill area, the very badly overgrown *Forsythia* collection was cut back, this being the only possible way of eliminating a bad fire hazard by the removal of all dead wood.

In an attempt to check the identifications of the very extensive living collections about 500 new labels with changed names were added, and about 400 broken labels were replaced by new ones. Approximately

2000 metal labels, and 2500 wooden display labels were prepared and placed during the year.

Accessions during the year include 2693 living plants received from various sources within the United States and 263 from foreign countries. Cuttings and scions added 193 to this list. Two hundred packets of seeds were received from eighteen foreign countries. Distributions from the Arboretum included 1831 living plants, 980 cuttings and scions, and 772 packets of seeds, to individuals and institutions in the United States and various foreign countries.

The card index list of living plants in the Arboretum has been thoroughly revised, various records eliminated, and others added. There are now approximately 6500 named species and varieties represented in the living collections, an extraordinarily large number when one considers that the institution handles only woody plants, and again when one considers the local climatic limitations. There is still a list of about 1100 additional species that at one time or another have been in cultivation at the Arboretum but which have been lost for one reason or another, that are worthy of re-trial. Arrangements have been made to re-acquire as many of these lost species as possible.

Cooperation has been extended to the Massachusetts Horticultural Society in connection with four exhibits sponsored by that organization. Assistance has been granted to the American joint committee on horticultural nomenclature in the revision of its "Standardized Plant Names." Many data have been supplied to the press on plants and plant problems. Work has been initiated on the much-needed task of revising and completing the detailed base map of the entire Arboretum, showing the exact location of each planted species and variety.

The circulation of the "Bulletin of Popular Information," one of the means whereby horticultural data are made available to the public, has been increased from 612, with 190 paid subscribers early in 1936, to 1500, of which 1200 are actual subscribers.

Plant Pathology. — The extension work of the laboratory of plant pathology has been especially heavy during the past year. This is particularly true with reference to requests for information and help on disease problems. Our interest in the Dutch elm disease situation in the United States has been actively maintained. There are indications that the disease is being controlled and to some extent the infected area being reduced, especially in the State of New York.

Our work on elm diseases at the adjunct field laboratory on Long Island was brought to a conclusion, and an account of the investigation

made there and at the Arboretum by Dr. D. B. Creager is to be published in July as Contribution no. 10 from the Arnold Arboretum.¹ This is a well-rounded piece of research on the cause, means of spread and control of a common, destructive, hitherto little understood, native wilt disease of the American elm caused by a fungus tentatively referred to the genus *Cephalosporium*. It constitutes a fine addition to the literature of elm diseases. Its publication was made possible by generous gifts from Mrs. Harold I. Pratt, Miss Helen C. Frick, Mr. George Van Yahres, and the Massachusetts Society for Promoting Agriculture.

Other significant investigations have been advanced and some publications on them issued. Among these mention should be made of the following: — (1) The physical basis of mycotrophy in *Pinus* by Dr. A. B. Hatch. This is an outstanding piece of work in that it demonstrates the helpful rôle of mycorrhizae in the growth of white pine and it explains that the value of mycorrhizae resides in the ability of the root-associated fungi to collect mineral salts where there is a lack of balance of them in the soil. (2) The control of *Gymnosporangium* rusts by means of sulphur sprays by Drs. J. D. MacLachlan and I. H. Crowell. This represents a valuable, practical conclusion of an admirable series of papers issued from the Arboretum on *Gymnosporangium* rusts harmful to *Juniperus* and various members of the Pomoideae. It is the first practical demonstration of the fact that the disease caused by these fungi can be controlled without having to resort to the radical practice of host eradication. The value of this method has been confirmed by New York State Agricultural Experiment Station and the procedure modified so as, at the same time, to control apple scab. (3) *Chrysomyxa Empetri* — a spruce-infecting rust. This adds another rust to the list known to attack spruces and it rounds out the life-history of a fungus long known only on species of *Empetrum*.

Cytology. — The cytological work during the past year has included two major projects. The first was a study on the effect of temperature on cell division. Extreme temperature changes may cause chromosome division without nuclear division, nuclear division without cell division, and cell division without nuclear division in the microspore development of *Tradescantia*. Chromosome aberrations also were caused by heat treatment.

The effect of temperature changes in causing chromosome division without nuclear division has been used to induce artificial polyploidy. Preliminary work has produced a tetraploid form of *Secale cereale* which

¹See cover page iii of this number.

is partially self-fertile, and a small population is being grown for experimental purposes. Similar work is being conducted with many of the shrubs in the Arboretum in order to produce polyploid forms of greater hardiness and vigor.

The second cytological project was a study of polyploidy in relation to geographic distribution. A study of the genus *Spiraea* confirms the earlier suggestions that the polyploid forms and species tend to occupy the periphery of the range of distribution. A comparison of diploid and tetraploid races shows a close relationship between chromosome number and cell size in many genera. This effect is reflected in the number of stomata per unit of leaf surface, and stomata counts can be used as a test of polyploidy in closely related forms and species grown under similar conditions. Stomata counts from herbarium material may be of value in indicating the extent of polyploidy in certain genera.

The Herbarium. — During the past fiscal year 24,410 specimens were inserted in the herbarium bringing the total to 454,472 mounted sheets. Of these accessions, 16,300 came from China and 600 from the rest of Eastern Asia, 4300 came from Malaysia, India and Indo-China, 759 from North America, 568 from Central and South America, and 582 from Australia.

Among the more important collections received during the last fiscal year may be mentioned 3337 specimens from Hainan received from the New York Botanic Garden, and an even larger collection from the same Island received from Sun Yatsen University; about 9000 specimens of Japanese plants from the herbarium of Kenzo Shiota representing 3240 species; 2194 specimens from San Domingo collected by Fuertes, received from the Berlin Botanical Museum; 1050 Mexican plants collected by Hinton; about 1000 Sumatran plants received from Prof. H. H. Bartlett, University of Michigan; 734 Australian plants collected by A. Morrison, received from Kew; 612 Mexican plants collected by F. L. Wynd; 602 specimens from the Belgian Congo; 533 Japanese plants collected by Kakuo Uno of Kobe; 335 plants from Greenland and Denmark, received from the Botanical Museum at Copenhagen; 222 plants from East Africa collected by H. J. Schlieben; 450 specimens from Shantung and Anhwei received from the University of Nanking; over 1000 specimens from F. G. Dickason, Rangoon, Burma; and 221 New Guinea plants collected by O. Warburg. Some of this material was acquired by exchange, some by purchase, and some for identification.

The collection of photographic negatives and critical specimens, chiefly Chinese, now amounts to 3513 numbers, 201 having been added during

the fiscal year. An alphabetical list has been prepared and will be sent on application to institutions desiring to exchange or purchase prints.

During the year only about 800 duplicates were distributed, owing to pressure of other work, but a general distribution of duplicate material will take place before the end of 1937. On loan to specialists in this country, Europe and Asia 3911 specimens were sent out.

Besides the constant use of the herbarium by members of the staff of the Arboretum, and also of other departments of the University for special studies, and for the determination of collections, and of plants sent in for identification, the facilities of the herbarium have been used by visitors, among whom may be mentioned: Dr. L. H. Bailey, Ithaca, New York; Professor Rodney True, University of Pennsylvania; Professor Wayne E. Manning, Smith College, Northampton, Mass.; Mr. E. H. Walker, National Herbarium, Washington, D. C.; Dr. G. L. Stebbins, University of California; Professor H. P. Brown, College of Forestry, Syracuse, New York; Dr. A. Gundersen, Brooklyn Botanic Garden; Professor Harold St. John, Honolulu; Dr. Rudolf Florin, Naturhistorisk Riksmuseum, Stockholm; Mr. F. G. Dickason, Judson College, Rangoon, Burma; Professor K. Kominami, Tokyo Imperial University. Dr. Lawrence Ames of the U. S. Department of Agriculture, Washington, is continuing his study of the species of *Berberis* at the Arboretum and their resistance to wheat-rust.

Members of the staff have been engaged in work on special subjects. Dr. E. D. Merrill has continued his work on the floras of Sumatra, Indo-China, and southern China, and in association with Dr. L. M. Perry has undertaken a critical revision of the species of *Eugenia* of China and of Borneo. In association with Miss Florence Freeman material has been assembled for a general revision of the known species of *Microtropis*.

Professor A. Rehder has concluded his study of the ligneous plants described by L veill  from Eastern Asia and has participated in the identification of collections of Chinese plants. Dr. I. M. Johnston is continuing his studies of Boraginaceae and is actively engaged in identifying a very large and important collection, approximating 5000 numbers, made for the University of California Botanic Garden in Peru, Bolivia, Chile, and Argentina. Dr. C. E. Kobuski has continued his study of the genus *Eurya* and expects to publish the result of his studies before the end of the year. Dr. Caroline K. Allen has pursued her work on the Chinese Lauraceae and will publish a synopsis of the species of *Litsea*, *Neolitsea* and *Actinodaphne* of China and Indo-China before the end of 1937. Dr. H. M. Raup has studied during the summer of last year the ecological conditions of the Black Rock Forest in the Hudson

Highlands of southern New York and has made general collections in that region; these studies are partly incorporated in his paper in the April number of this Journal. Mr. E. J. Palmer is continuing his study of *Crataegus* and has started to make a complete collection of herbarium material of all the trees and shrubs growing in the grounds to aid in a more intensive study of the cultivated forms.

Grants to support botanical exploration of China during 1936 have again been made to the Fan Memorial Institute of Biology in Peiping, and to the Botanical Department of Lingnan University in Canton. In behalf of the former, Dr. H. H. Hu had sent out an expedition under Mr. C. H. Wang to Yunnan; while for the Lingnan University, Prof. F. P. Metcalf had sent an expedition under Mr. W. Y. Tang to Hunan, Kwangtung and adjoining Indo-China. Late in the year a grant was made to Sun Yatsen University, Canton, to enable Prof. W. Y. Chun of that institution to explore certain parts of southern China. In association with the Farlow Herbarium, financial assistance was granted to Prof. B. B. Mundkur to cover the cost of field work in northern India.

The Library. — During the past academic year there have been added to the Library 424 bound volumes, 527 pamphlets and 87 photographs, the total number of accessions now comprising 42,971 bound volumes, 12,003 pamphlets, 17,809 photographs, and 300 unbound volumes. A total of 9,590 cards were distributed in the various indices, and 1,894 slips were filed in the supplement to the author and subject catalogue of the library, making the number of slips now ready for publication 24,699. One hundred and ninety-three volumes have been bound, and one hundred and forty pamphlets put in pamphlet binders. The number of inter-library loans has been large and 123 photographs have been sold for reproduction in various publications. Visitors registered in the library number 168, including many from foreign countries as well as from all parts of our own country. A short sketch of the Library from its beginning to the present was published in the Bulletin of Popular Information for June 11, 1937.

Atkins Institution of the Arnold Arboretum, Soledad, Cienfuegos, Cuba. — During the summer of 1936 much time and attention was given to the renovation of the plantings injured by the great hurricane of 1935. Badly injured plants had to be severely pruned to remove dead or dying parts and where root damage had resulted from root twisting, tops had to be cut back to give proper balance between roots and tops and to stimulate new growth. The results have been excellent. Much thinning

has been done to permit the development of better specimen plants, and where the same species was represented by scattered specimens, the inferior plants were eliminated.

Scattered representatives of the ferns, lilies, vines, etc. have been assembled in central locations where they can be given better attention, and in the vine section the old wooden supports have been replaced by metal arches. The pipe system has been rearranged with more numerous outlets to facilitate irrigation and watering. The acquisition of a power mower has greatly reduced labor costs in the maintenance of lawns.

In the *seburuco*, an area characterized by native vegetation, grass has been removed to provide places for planting selected native timber trees, the native orchids have been assembled in one place, while the exotic orchids have been assembled in another place. A special area has been cleared for the cactus and succulent garden. East of the *seburuco* the swampy area has been drained in preparation for planting, four acres to the southeast, and an additional twelve acres west of the garden towards Harvard House have been cleared, fenced and partly planted.

The living collections were increased by the addition of 390 species. In exchange 721 packets of seeds, 762 plants (including 173 orchids) and 138 cuttings were received. During the year 1292 packets of seeds were distributed.

Students and investigators at the Atkins Institution during the year included Dr. Lyman Smith and Mr. A. R. Hodgdon of the Gray Herbarium, for the purpose of prosecuting general botanical field work, Mr. O. Tippo, Mr. Charles Heimsch, and Demorest Davenport of the Biological Laboratory, and Mr. Harold A. Senn, of the University of Virginia. Professor J. G. Needham of Cornell University was in residence for several weeks working on the life history of certain dragon flies, and Mr. D. E. Davis spent several months at Soledad working on the life history of the *ani*, a bird having communal nesting habits. The garden was visited in May by Major Johnstone, an English amateur specializing in the study of palms. Professor Thomas Barbour, Custodian, as usual, spent considerable time at Soledad in the early part of 1937, conferring with the resident staff on desirable changes and improvements. A number of other visitors were entertained at Harvard House for shorter periods, chiefly those interested in one type of research or another.

Of particular interest to those who visit Soledad is the fact that the new road from Cienfuegos, passing the Atkins Institution is finished, and on the occasion of its opening the President of Cuba was to attend and visit the Garden.

Publications. — The usual issues of the "Journal" and the "Bulletin of Popular Information" have been issued, but no other special publications have appeared. A number of technical, semitechnical, and popular articles prepared by staff members have been published in extra-institutional serials. Late in the year arrangements were perfected for the very extensive Merrill-Walker "Bibliography of Eastern Asiatic Botany." This extensive work containing approximately 23,000 author entries has been in the course of preparation since 1927. It was to have been published by the Smithsonian Institution, but funds were not available to cover the rather large printing bill. It became possible for the Arboretum to publish this large volume, estimated at 600 pages, quarto, through a generous grant made by the Harvard-Yenching Institute, and a smaller donation from the Smithsonian Institution. These two grants provided slightly in excess of one-third of the amount required, but with this support in hand, an anonymous friend of the Arboretum generously offered to supply the balance required to meet the bill. The volume is expected to be off the press late in 1937 or early in 1938.

**Bibliography of the published writings of the staff and students
July 1, 1936—June 30, 1937**

- CREAGER, D. B. Cephalosporium wilt of elms. (Proc. Nat. Shade Tree Conf. **12**: 140-144. 1936.)
- CROWELL, I. H. Relative susceptibility of lilac species and varieties to *Microsphaera Alni*. (U. S. Dept. Agr. Plant Disease Reporter **21**: 134-138. 1937.)
- FAULL, J. H. *Cryomyxa Empetri*—a spruce-infecting rust. (Jour. Arnold Arb. **18**: 141-148, *pl.* 202-203, *fig.* 1937.)
- Pathological studies on beech at the Arnold Arboretum. (Proc. Nat. Shade Tree Conf. **12**: 21-29. 1936.)
- HUNTER, L. M. Morphology and ontogeny of the spermogonia of the Melampsoraceae. (Jour. Arnold Arb. **17**: 115-152, *pl.* 182-188. 1936.)
- JACK, J. G. Arboreta old and new. (Sci. Monthly **43**: 541-550. 1936.)
- JOHNSTON, I. M. Studies in the Boraginaceae. xii. (Jour. Arnold Arb. **18**: 1-25. 1937.)
- KOBUSKI, C. E. Studies in Theaceae. II. *Cleyera*. (Jour. Arnold Arb. **18**: 118-129, *pl.* 201. 1937.)
- LOTT, H. J. An interesting mutation. (Horticulture (Boston), **15**: 192. 1937.)
- MACLACHLAN, J. D. The pimento rust disease. (Jour. Jamaica Agr. Soc. **40**: 277-281. 1936.)
- & CROWELL, I. H. Control of the gymnosporangium rusts by means of sulphur sprays. (Jour. Arnold Arb. **18**: 149-163, *pl.* 204. 1937.)
- MERRILL, E. D. On the application of the binomial *Amaranthus viridis* Linnaeus. (Am. Jour. Bot. **23**: 609-612, *fig.* 1936.)
- The Cabot foundation for botanical research. (Harvard Alumni Bull. **39**: 1018-1021. 1937.)